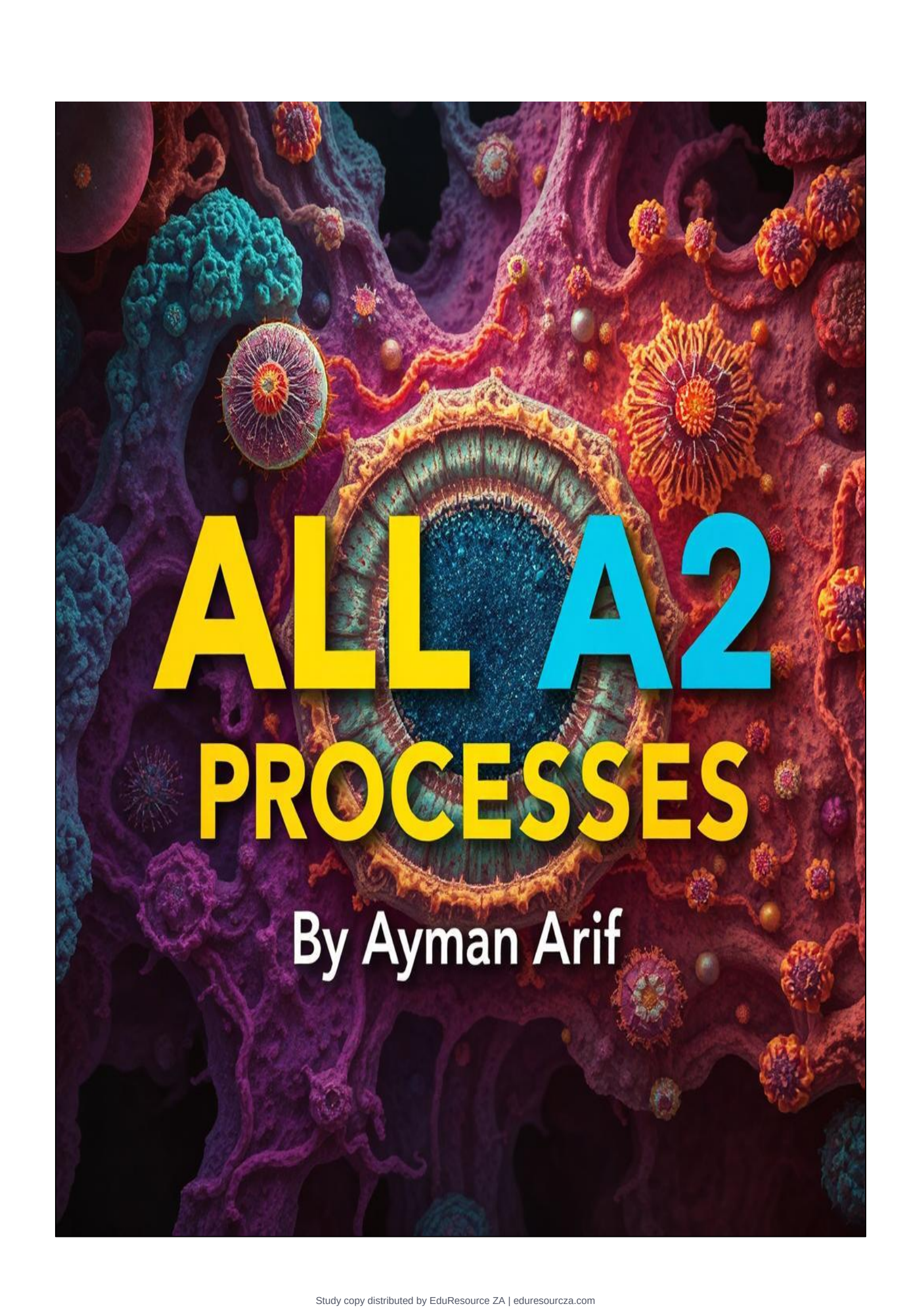




ALL A2 PROCESSES

By Ayman Arif

1. Chapter 12

- 1.1 - Aerobic Respiration
- 1.2 - Anaerobic Respiration
- 1.3 - Adaptations of Rice Plants

2. Chapter 13

- 2.1 - Photosynthesis Process
 - a) Light Dependent
 - I] Cyclic
 - II] Non-Cyclic
 - b) Light Independent

3. Chapter 14

- 3.1 - Ultrafiltration
- 3.2 - Reabsorption in the PCT
- 3.3 - Osmoregulation LWP In Blood
- 3.4 - Control of Blood Glucose
 - a) HB Glucose concⁿ
 - b) LB Glucose concⁿ
- 3.5 - Opening & Closing Of Stoma
 - a) Opening of Stoma
 - b) Closing of Stoma
- 3.6 - Biosensor & Dipstick
 - a) Biosensor
 - b) Dipstick

4. Chapter 15

- 4.1 - Impulse Transmission
- 4.2 - Transmission Across Neuromuscular Junction
- 4.3 - Muscle Contraction
- 4.4 - Venus Fly Trap
- 4.5 - Auxin In Elongation
- 4.6 - Gibberellin
 - a) Synthesis
 - b) Germination

5. Chapter 16

- 5.1 - Crossing Over
- 5.2 - Independent Assortment
- 5.3 - Genetic Disorders

- a) Albinism
 - b) Haemophilia
 - c) Sickle Cell Anaemia
- 5.4 - Lac Operon
- a) Lactose Present
 - b) Lactose Absent

6. Chapter 17

- 6.1 - Antibiotic Resistance
- 6.2 - Artificial Selection
- 6.3 - Speciation
 - a) Allopatric
 - b) Sympatric

7. Chapter 18

- 7.1 - Reasons to maintain Biodiversity

8. Chapter 19

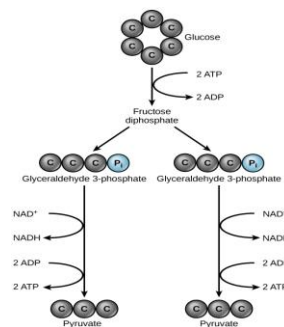
- 8.1 -
- 8.2 -

CHAPTER 12

1.1 - Aerobic Respiration

Glycolysis:

- Glucose is phosphorylated by 2 ATP to give fructose-1,6-bisphosphate (6C)
- Which splits into 2 molecules triose phosphate (3C)
- Hydrogen removed from each molecule and transferred to NAD to form NADH
- Pyruvate is formed

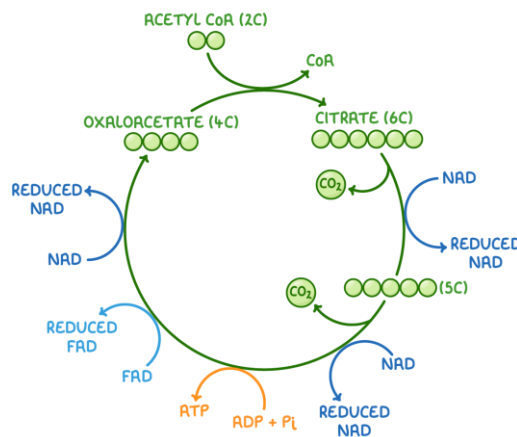


Link Reaction:

- Pyruvate is decarboxylated and dehydrogenated to give Acetyl Group
- Which combine with CoA to produce Acetyl CoA

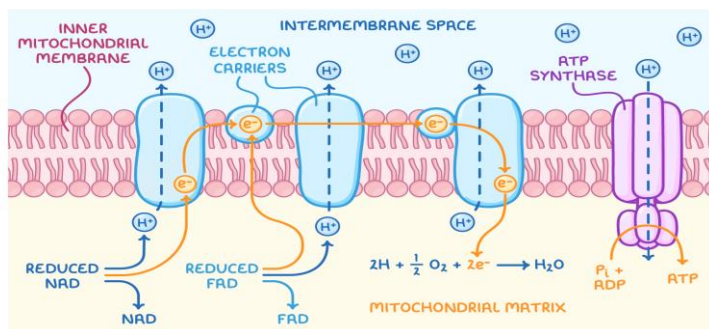
Krebs Cycle:

- Acetyl CoA combines with oxaloacetate to form Citrate
- Citrate undergoes decarboxylation and dehydrogenation to produce 2CO₂, 3NADH₂ AND FADH₂
- ATP is formed via SLP



Oxidative Phosphorylation:

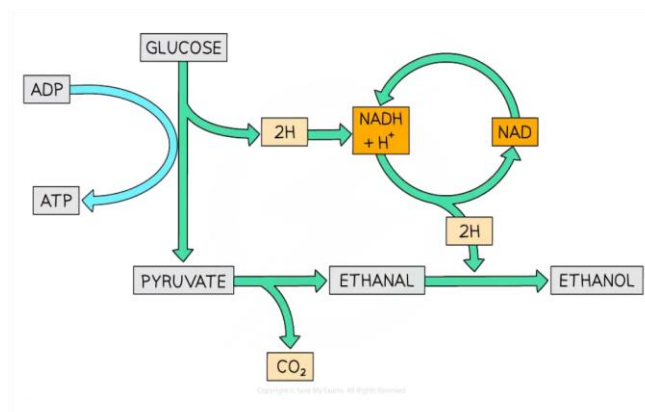
- FADHS & NADH₂ release H atom by dehydrogenase
 - H atom splits to H⁺ and e⁻
 - e⁻ are transferred to the ETC
 - They release energy while moving
 - The energy is used to pump H⁺ from matrix to intermembrane space
 - A proton Gradient is set up due to high concⁿ of H⁺ in the space
 - H⁺ move back into matrix by FD through ATP synthase
-
- ATP is synthesized by Chemiosmosis
 - O₂ acts as e⁻ and H⁺ acceptor forming water



1.2 - Anaerobic Respiration

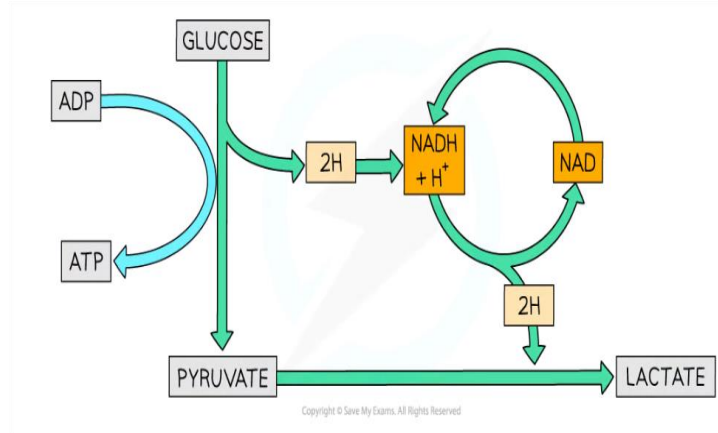
Yeast:

- Glycolysis occurs as usual
- Pyruvate is decarboxylated to Ethanal by ethanol dehydrogenase
- Ethanal is the H acceptor
- It is reduced to ethanol by reduced NAD
- NAD is regenerated for continuation of Glycolysis
- Ethanol can't be further metabolised



Mammals:

- Glycolysis occurs as usual
- Pyruvate is the H acceptor
- It is reduced by reduced NAD to lactate using lactate dehydrogenase
- NAD is regenerated for continuation of Glycolysis
- Lactate can be further metabolised
- Lactate can be oxidised back to pyruvate or it can be converted to glycogen for storage



1.3 - Adaptations of Rice Plants

- Rice grows taller by gibberellin which stimulates cell elongation in response to flooding
- Have Aerenchyma tissues in their stems and roots which contain airspaces that allow gases that enter the stoma to diffuse to other parts of the plant
- Have ethanol dehydrogenase to break down ethanol
- More ATP will be produced

CHAPTER 13

2.1 - Photosynthesis Process

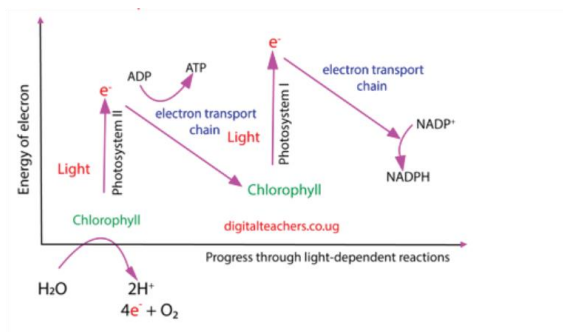
a) Light Dependent:

I] *Cyclic*

- Only PS1 is involved
- Light energy is absorbed by PSI
- Energy is channelled to the Reaction Centre
- The energy excites an e^-
- e^- is emitted and captured by an electron acceptor
- The e^- is passed along the ETC
- The e^- lose energy as they move through the ETC and that energy is used to actively move H^+ from stroma to thylakoid space
- A proton gradient is set due to collection of H^+
- H^+ move down the concⁿ gradient back into the stroma by FD through the ATP synthase
- ATP is synthesized by chemiosmosis
- e^- flow back to the PS1

II] *Non-Cyclic*

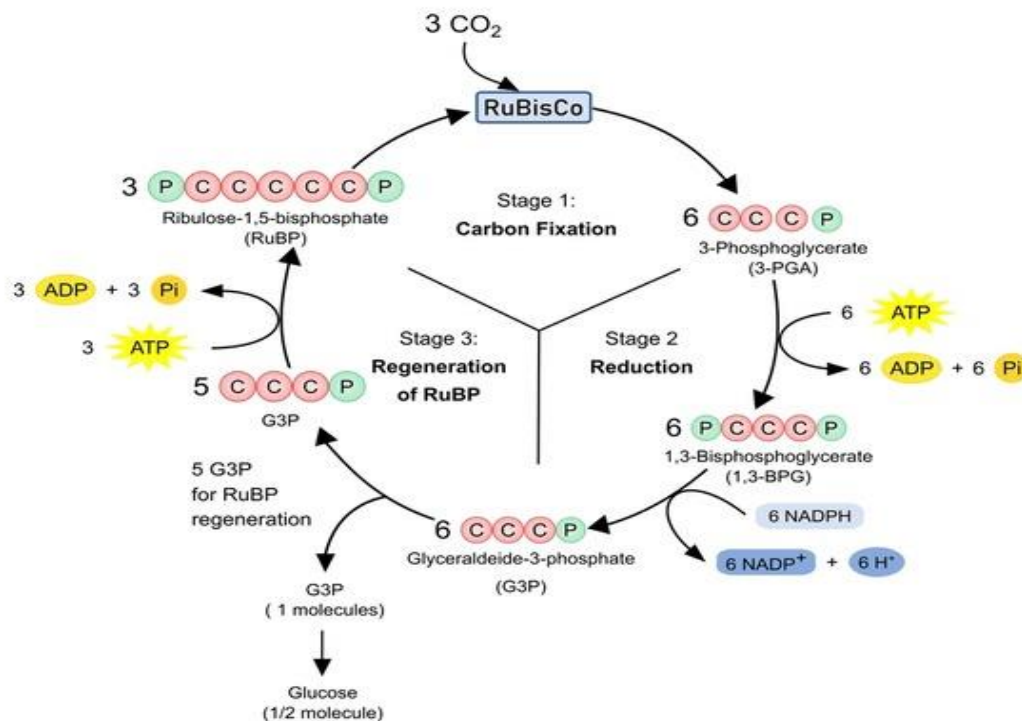
- Involves both photosystems (PSI & PSII)
- Light energy is absorbed by both photosystems
- The light energy is channelled to the Reaction Centre
- Photoactivation occurs
- The e^- are passed from PSII to PSI via ETC
- This movement releases energy which is used to synthesise ATP by chemiosmosis
- Photolysis of water occurs to replace lost e^- of PSII
- e^- from PSI & H^+ from photolysis combine with NADP to form reduced NADP
- O_2 is produced as a waste product



b) Light independent

- RuBP combines with CO_2
- Rubisco catalyses the reaction
- An unstable 6C compound is formed
- Splits in half to give 2x Glycerate 3-phosphate (GP)
- GP is reduced by reduced NADP and ATP from LDR
- Forms Triosephosphate (TP)
- Most of the TP are used to regenerate RuBP actively

Calvin Cycle



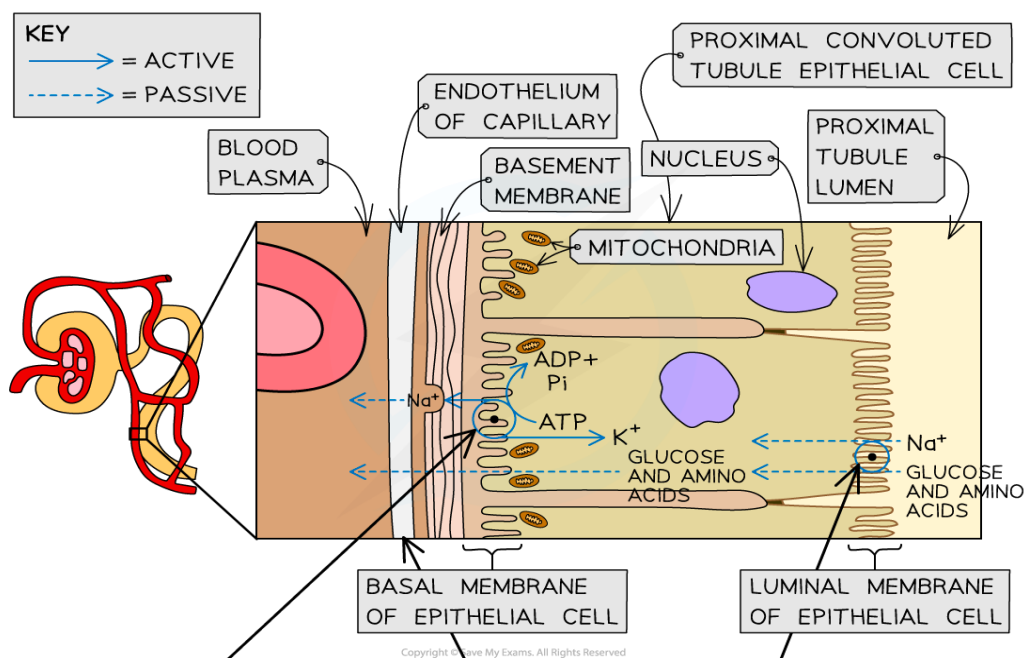
CHAPTER 14

3.1 - Ultrafiltration:

- High pressure forces substances out of the capillaries to the capsule
- This increases the water potential in the capillaries
- Water moves down water potential gradient into the capsule
- The holes in capillary walls and space between podocytes allow substances dissolved in blood to pass through
- The basement membrane acts as a filter as it stops large protein molecules from getting through

3.2 - Reabsorption in the PCT:

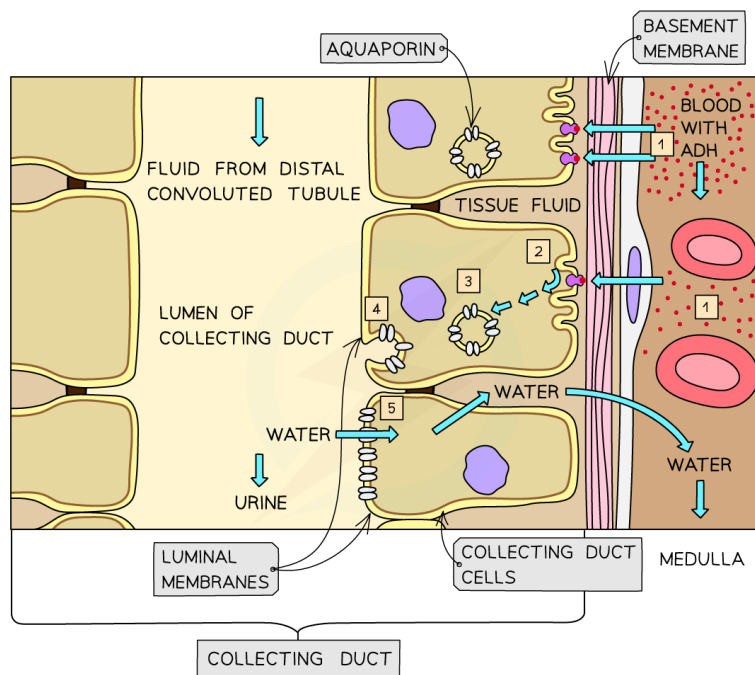
- Na^+ & K^+ channels on the basal membrane pumps Na^+ out of the proximal convoluted cell into the blood actively
- The concⁿ of Na^+ in the cells decrease
- Na^+ moves down their concⁿ gradient from the filtrate into the PC cells through co-transporter proteins
- At the same time, they transport glucose molecules and amino acids
- High solute concⁿ builds up in the PC cells
- Solutes move down their concⁿ gradient through co-transporter proteins into the blood in the capillaries
- By Facilitated Diffusion
- Removal of solutes in the filtrate rises the water potential
- Water moves down water potential gradient through the PC cells and into the blood



3.3 - Osmoregulation:

-Low Water Potential

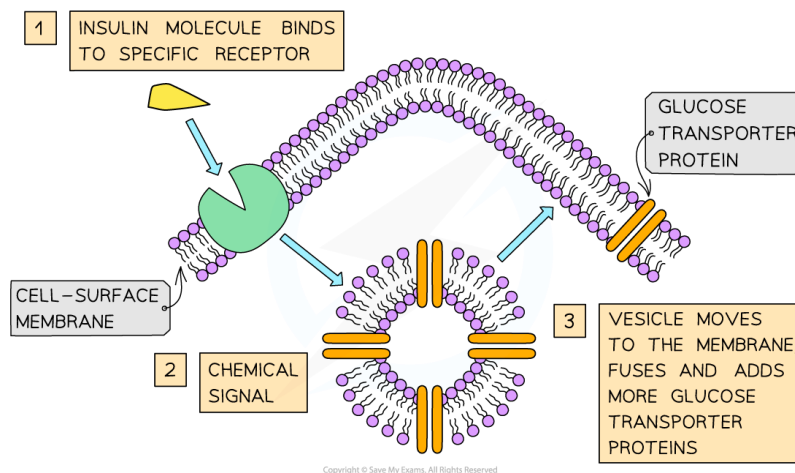
- Change is detected by the osmoreceptors in the hypothalamus
- Hypothalamus produces Anti Diuretic Hormone (ADH)
- Posterior pituitary gland secretes the ADH
- ADH travels in blood to target cells (collecting duct cells)
- ADH binds to the receptors on the membrane of the CDC
- Binding stimulates the activation of cyclic AMP (c-AMP) which acts as a secondary messenger
- c-AMP will activate cascade reactions
- Aquaporins are phosphorylated
- Vesicles with aquaporin on the membrane move towards the luminal membrane of the collecting duct cells
- Vesicles fuse with the luminal membrane
- This increases permeability of the luminal membrane to water
- Water moves down water potential gradient through aquaporins into the blood in the capillaries
- This increases the concⁿ of urine and decreases the volume



3.4 - Control of Blood Glucose:

a) HB Glucose Concⁿ

- Change is detected by the α and β cells in the pancreas
- The β cells respond by producing Insulin
- Insulin travels to the liver cells/muscles cells which are target cells
- Insulin binds to the receptor on the CSM of the cells
- The binding stimulates the movement of vesicles with Glucose Transport Proteins to move to the CSM
- The vesicles then fuse with the CSM
- Which increases the permeability of the CSM to glucose molecules
- Rate of facilitated diffusion of glucose into target cells increases
- Insulin activates an enzyme which phosphorylates glucose called Glucokinase making it impermeable to the CSM
- Insulin activates an enzyme which converts glucose to glycogen called glycogen synthase



b) LB Glucose concⁿ

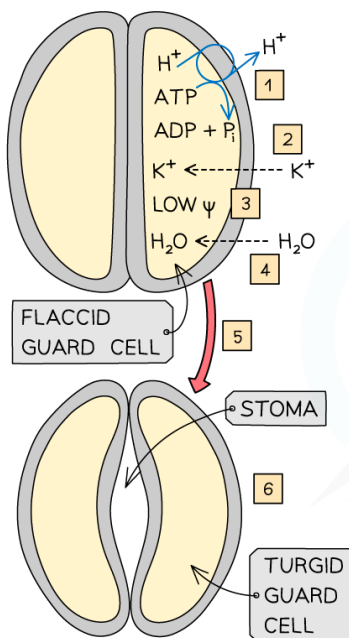
- Change is detected by α and β cells in the pancreas
- The α cells secrete glucagon
- Glucagon binds to the receptors on the CSM on the liver cells
- The receptor changes shape and activates G-protein
- Which activates Adenyl cyclase
- The enzyme catalyses the conversion of ATP to c-AMP
- c-AMP acts as a second messenger
- Which initiates enzyme cascade

- Activates glycogen phosphorylase enzymes which catalyse the breakdown of glycogen to glucose

3.5 - Opening and Closing of Stoma

a) Opening of Stoma

- H^+ are actively pumped out of the guard cells by the H^+ pumps
- The H^+ concⁿ inside the cell decreases
- K^+ channels open and allowing entry of K^+
- Entry of K^+ lowers the water potential inside the cells
- A water potential gradient is set
- Water moves down water potential gradient by osmosis
- Through aquaporins
- This increases turgor pressure
- The thin outer walls bend more easily hence causing the cell to become curved and stoma to open



Note: To further decrease the water potential during opening of stomata and to maintain the electrical balance, starch stored in chloroplasts is broken down to the negatively charged malate ions, which then enter the vacuoles.

b) Closing of Stoma

- ABA binds to its receptor on the guard cell surface membrane
- Binding inhibits the H^+ pumps to stop pumping the H^+ out of the cell
- ABA stimulates the movement of Ca^{2+} into the cytoplasm of the guard cell

- Ca^{2+} act as 2nd messenger
- They cause channel proteins to open that allow negatively charged ions to leave the guard cells
- Also closes K^+ channels that allow K^+ to enter the cell
- The loss of solute concⁿ rises the water potential
- Water leaves the guard cells by osmosis
- Cells become flaccid and stoma closes

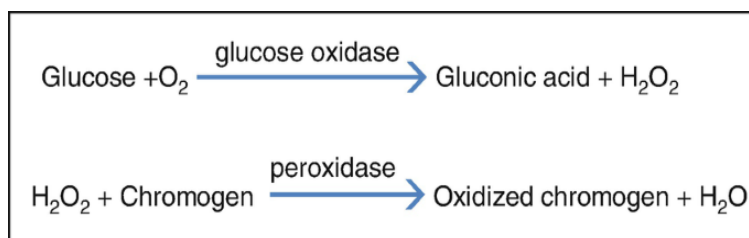
3.6 - Biosensor & Dipstick

a) Biosensor

- Has immobilized enzyme (glucose oxidase & peroxidase)
- Blood on strip is placed into the biosensor
- Glucose in blood plasma pass through the membrane and binds to the active site of the glucose oxidase
- Where it is catalysed to gluconic acid and hydrogen peroxide
- Hydrogen peroxide is $[\text{O}]$ at an electrode where e^- transfer is detected
- The e^- flow generate current
- The current is amplified and read by the meter as digital value
- Glucose $\propto$ current $\propto$ reading

b) Dipstick

- Has immobilized enzyme (glucose oxidase & peroxidase)
- The pad is dipped into urine
- Glucose is $[\text{O}]$ to gluconic acid and hydrogen peroxide
- Peroxidase catalyses the reaction of hydrogen peroxide and chromogen
- Chromogen changes colour as it is oxidized
- The colour of the pad is compared with the colour chart which shows colours of different concentrations of glucose.
- The more the glucose the darker the colour



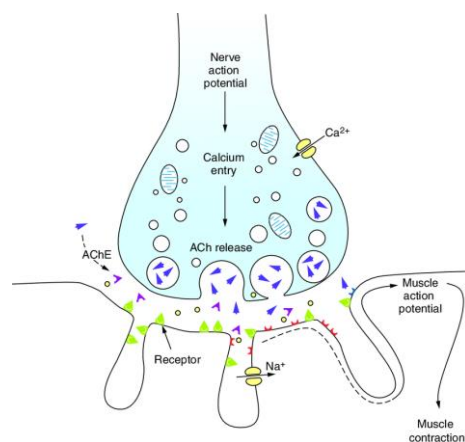
CHAPTER 15

4.1 - Impulse Transmission

- Stimulation of neurone on one end, causes the opening of Na^+ voltage gated channel in the CSM
- Na^+ diffuses into the cell.
- The inside of the axon becomes more positive & the potential difference become +30mV
- The membrane is depolarized.
- A local circuit is created between nodes of Ranvier
- The local circuit causes opening of Na^+ voltage gated channel at the next node of Ranvier
- This causes new action potential in the next node of Ranvier.
- As Na^+ diffuses in, after 1 ms all the Na^+ voltage gated channels close, stopping Na^+ diffusing into the cells
- At the same time K^+ voltage gated channels open and allow K^+ diffuse out.
- K^+ channel close making the inside become negative and the potential difference returns to – 70mV (repolarization)

4.2 - Transmission Across Neuromuscular Junction

- The arrival of an action potential at the presynaptic membrane causes depolarisation of the membrane
- This stimulates voltage-gated Ca^{2+} channels to open
- Ca^{2+} ions diffuse down an ECG into the presynaptic neurone
- Stimulating ACh-containing vesicles to move and fuse with the presynaptic membrane
- Releasing ACh molecules into the synaptic cleft by exocytosis
- The ACh molecules bind to receptor proteins in the postsynaptic membrane
- Binding causes the opening of Na^+ channels and they diffuse into the sarcolemma
- Causing depolarization of the sarcolemma
- ACh molecules are broken down by Acetylcholinesterase into acetate and choline
- The choline is absorbed back into the presynaptic membrane and recycled to ACh



4.3 - Muscle Contraction

- action potential arrives at the neuromuscular junction
- Depolarization occurs
- Ca^{2+} are released from the sarcoplasmic reticulum by FD
- Ca^{2+} bind to troponin stimulating them to change shape
- This causes troponin and tropomyosin proteins to change position on the actin filaments
- Myosin binding sites are exposed
- Heads of the myosin molecules bind with these sites, forming cross-bridges
- The myosin heads move and pull the actin filaments towards the M-line
- ATP hydrolysis occurs at the myosin heads, providing the energy required for the myosin heads to release the actin filaments
- The myosin heads move back to their original positions and bind to new binding sites on the actin filaments
- Process repeats until muscle is fully contracted

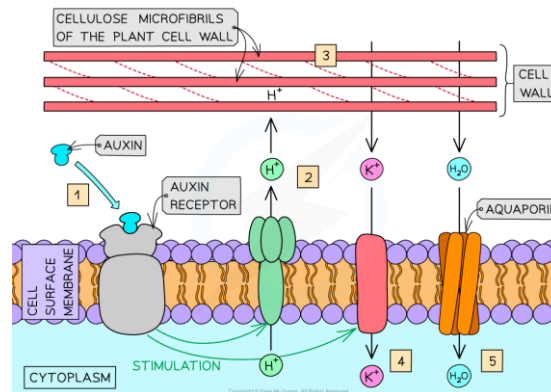
4.4 - Venus Fly Trap

- Deflection of 2 sensory hairs within a period of 20/30s causes generation of receptor potential above threshold
- Action potential reaches lobe of leaf
- Auxin is stimulated to bind to the receptor on the CSM
- Auxin stimulates the proton pumps to actively pump H^+ out of cell/into cell walls of midrib cells
- The pH decreases in the cell wall and causes the loosening of the cell wall
- Calcium pectate (bond) breaks down
- Ca^{2+} enter the cells
- Increase in ions causes decrease in water potential in the cells
- Water enters the cells down water potential gradient by osmosis
- Cells become turgid
- Leaves/lobes become concave

4.5 - Auxin in Elongation

- Auxin binds to receptor on CSM
- Stimulates H^+ pumps (ATPase) to pump H^+ actively into the cell wall from cytoplasm
- The pH in the cell wall decreases
- Activates proteins called expansins which loosen the bond between cellulose microfibril
- Cell wall loosens
- K^+ channels are activated to open at the same time
- K^+ rush into the cell
- Decreasing water potential in the cell

- Water enters the cell by osmosis through aquaporins
- Increasing the internal pressure causing the cell wall to stretch
- Cell elongates



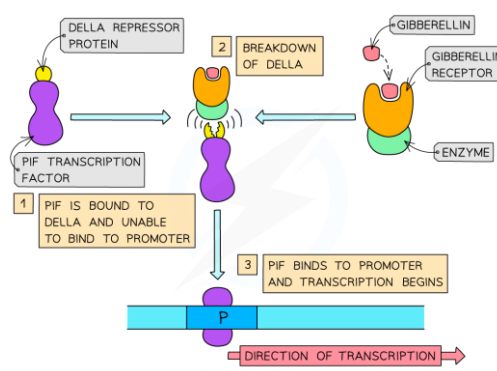
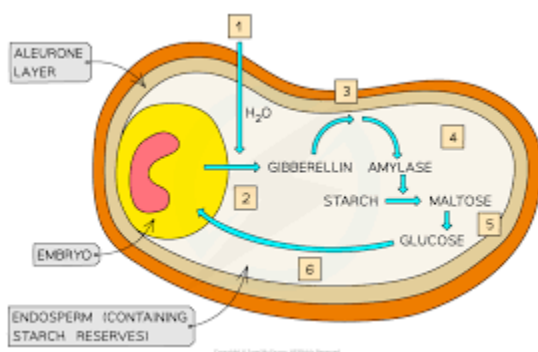
4.6 - Gibberellin

a) Synthesis

- Controlled by a gene with two alleles Le and le
- Le codes for functional enzyme
- Which produces active form of gibberellin

b) Germination

- When water enters a dormant seed, it activates the seed to synthesize gibberellin
- Gibberellin diffuses to aleurone layer
- It binds to its receptor and an enzyme
- Causes breakdown of DELLA protein
- Which allows the PIF to bind to the promoter and transcribe the genes for amylase
- Amylase is produced
- Amylase hydrolyses starch into maltose and then glucose
- Glucose used in respiration and growth



CHAPTER 16

5.1 - Crossing Over

- Homologous chromosomes move closer together in prophase I
- Non-sister chromatids have different allele combinations
- Chromatids cross each other and form chiasmata
- Non-sister chromatids are swapped
- Exchange of allele takes place
- New combinations of alleles are formed in the chromatids

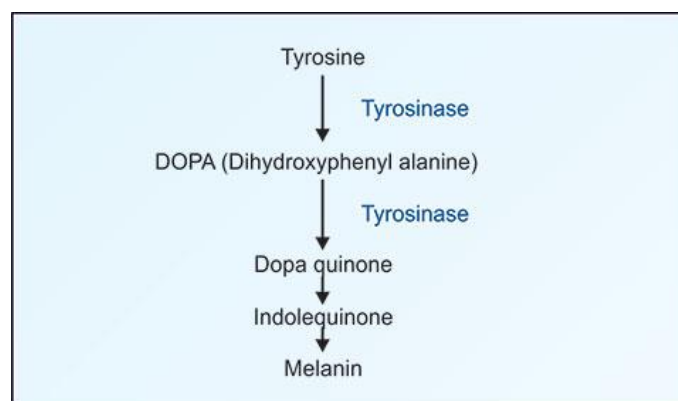
5.2 - Independent Assortment

- Homologous chromosomes line up randomly
- At the equator/metaphase plate
- Homologous chromosomes are randomly separated into gametes
- Leads to different combinations of chromosomes in the daughter cells
- 2^n different combinations

5.3 - Genetic Disorders

a) Albinism

- Mutation occurs in TYR gene
- Primary structure of protein is changed
- 3D structure and active site change
- Inactive tyrosinase produced
- Conversion of tyrosine to DOPA to dopaquinone to melanin won't take place



b) Haemophilia

- Mutation in F8 gene
- Causes no Factor VIII to be produced
- Blood clotting is prevented
- Results in excessive bleeding

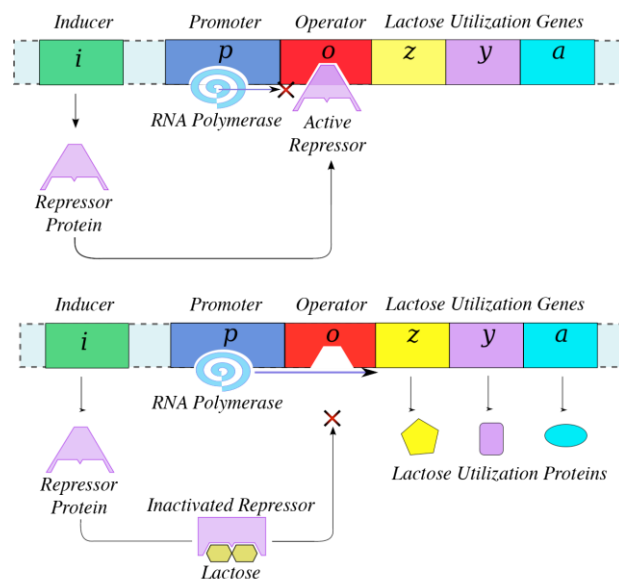
c) Sickle Cell Anaemia

- Mutation in the HBB gene
- Base T in triplet code CTT is replaced by A forming CAT
- CAT codes for hydrophobic Valine
- Haemoglobin becomes less soluble
- Making the molecules stick together
- RBC's become sickle shaped and transport less O₂
- RBC's get stuck in capillaries and cause pain

5.4 - Lac Operon

a) Lactose present

- Repressor protein bound to the operator
- Lactose binds to the repressor protein
- Repressor protein changes shape
- It then gets detached as it is no longer complimentary in shape to the operator
- Exposing the operator and promoter
- RNA polymerase binds to the promoter
- Initiating transcription of the 3 structural genes



b) Lactose Absent

- Regulatory gene codes for lac repressor protein
- Repressor protein binds to the operator
- RNA polymerase cannot bind to the promoter
- No transcription of the 3 structural genes

Note: *Lac Z* – hydrolyses lactose, *Lac Y* – increases uptake of lactose, *Lac A* – detoxification

CHAPTER 17

6.1 - Antibiotic Resistance

- Random mutation
- Produces variation among bacteria
- Type of directional selection
- Antibiotics acts as a selection pressure
- Resistant bacteria have a selective advantage
- Resistant bacteria will survive and reproduce by binary fission
- Resistant allele will be passed onto the offspring
- The frequency of resistant allele increases

6.2 - Artificial Selection

- Humans apply selection pressure
- Choosing those with best features to breed
- The organisms are bred and some advantageous allele is passed to the offspring
- Offspring showing the desirable features are selected for breeding
- This process is repeated over many generations
- Until all organisms show desired characteristics
- The frequency for desirable allele increases

6.3 - Speciation

a) Allopatric

- Two population of the same species are separated by geographical barrier
- No gene flow between the two groups
- Different mutations may occur
- Different selection pressures acting on the populations
- All resulting in new allele formation
- Over time the, physiological and behavioural features become so different
- The two populations will not be able to interbreed over time
- New species have evolved

b) Sympatric

- Two populations split without any geographical barrier
- Behavioural and ecological separations
- No gene flow between the two groups
- Over time the two groups of organisms become very different
- The two groups will not be able to interbreed

CHAPTER 18

7.1 - Reasons to maintain Biodiversity

a) Economic Reasons

- Many medicines have originated from plants, fungi and bacteria
- Ecotourism – many tourists travel to and spend money in national parks to see wildlife
- Have made major contributions to the field of science and technology

b) Aesthetic Reasons

- Humans find joy and pleasure in the beauty of nature
- Provides inspiration for creatives such as photographers and writers

c) Social & Environmental Reasons

- Many people enjoy spending time in the natural environments
- Plants absorb carbon dioxide from the atmosphere and help to reduce the greenhouse effect and climate change
- Microorganisms digest and break down the masses of organic waste that are produced by larger organisms
- Humans have irrigation and drinking water thanks to the transpiration of plants and their contribution to the water cycle
- Different fungi and bacteria species are a major part of the nutrient cycle that allows for nutrients to re-enter the soil for further plant growth
- Plants are producers in food webs; they are both a direct and indirect energy source for humans through fruit, vegetables and meat

Summary of reasons for maintaining biodiversity table

Moral and ethical	Humans have a responsibility to reduce their impact on the planet and on other species.
Ecological	Biodiversity increases the stability of ecosystems.
Environmental	Organisms provide essential environmental services (e.g. water cycle, nutrient cycle, absorption of carbon dioxide, pollination).
Economic	A range of organisms contribute to medicine, ecotourism, science and technology.
Aesthetic	Humans take pleasure from the sensory stimuli that biodiversity can provide.
Agricultural	Genetically diverse wild species can rescue crops from catastrophes.

CHAPTER 19

**For more Info contact
+255786930931
@akahajii in Instagram**